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Possible Storage Ring Upgrades

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Boundary Conditions

- Use existing storage ring tunnel
- All beamlines (sectors 1~35) will be preserved
 - Can continue operation with no change in performance if so desired
 - Bending magnet beamlines (sectors 1~35) may require realignment
- 7 GeV is target, 6 GeV is minimum energy
- Existing beam stability will be maintained
- Existing bunch patterns will be maintained
 - E.g., 24 bunch, 1296, hybrid mode
- Single bunch current limit will be maintained
 - E.g., 16 mA in hybrid mode.

Goal for the Upgrade

- Provide upgraded experimental capabilities on multiple fronts
 - Support for time-resolved studies requiring picosecond pulses
 - Improved transverse coherence
 - *E.g., coherent diffraction studies*
 - Improved imaging
 - *E.g., phase-contrast imaging*
 - Significantly longer straight sections, e.g.,
 - *Fast polarization switching*
 - *More canted devices*
 - Improved beam stability to match emittance reductions.

Promise of a Storage Ring Upgrade

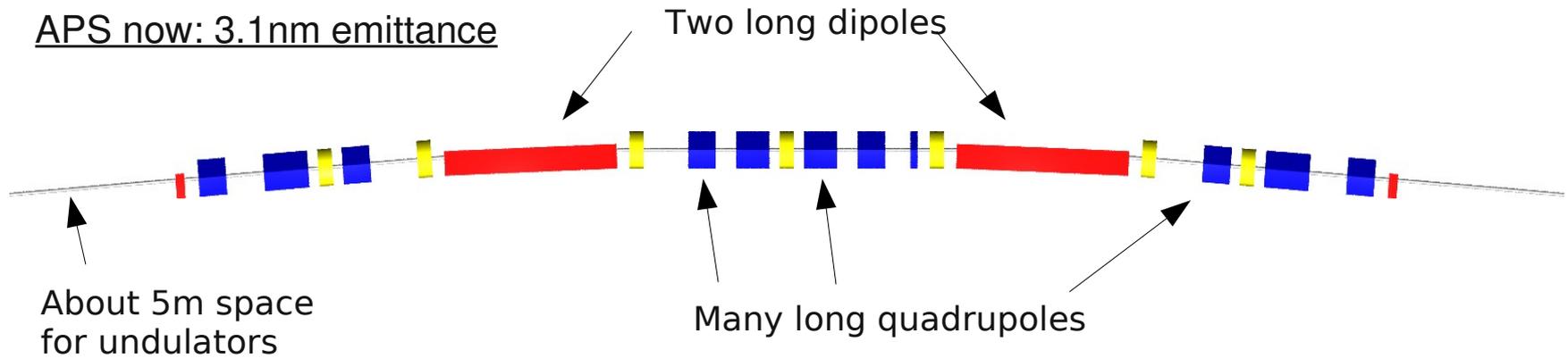
- Could upgrade the APS storage ring to provide
 - Longer straight sections
 - Lower emittance
 - Higher current
 - Short x-ray pulses
 - Novel insertion devices
 - Customized source properties
- Do nothing to preclude ERL upgrade in the future.

Long Straight Sections Very Important

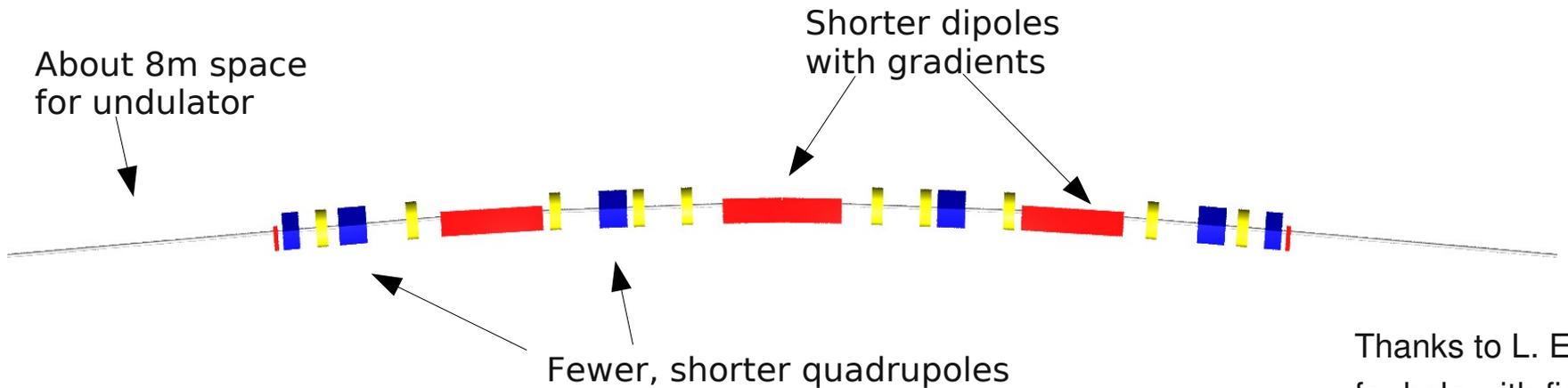
- APS straight sections now allow 4.8 m for insertion devices
- Longer straight sections interesting for many reasons
 - Flux-starved experiments
 - Long devices for reduced x-ray bandwidth
 - Getting more from expensive end station equipment by having several IDs
 - Canted devices to increase number of simultaneous experimental stations
 - Provides more space for cryostats for superconducting crab cavities.

Triple-Bend Design (APS1nm)

APS now: 3.1nm emittance



Possible upgrade: 1nm emittance

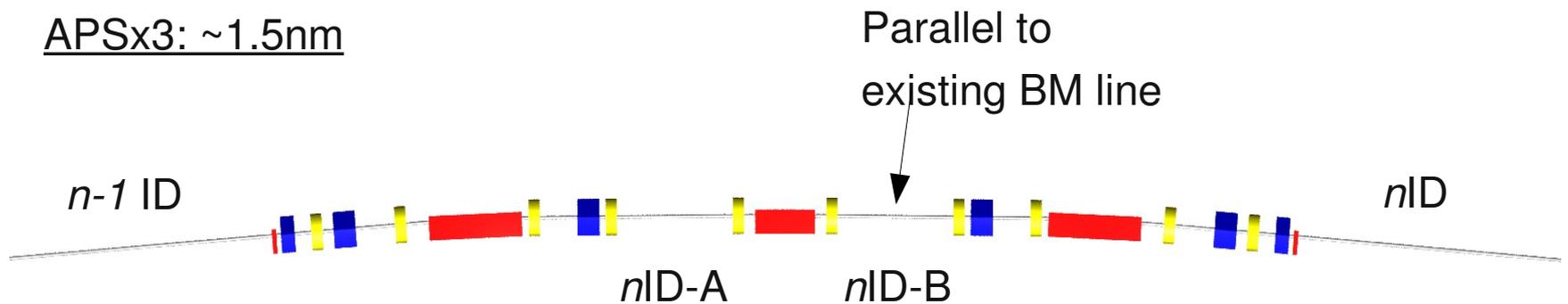


Thanks to L. Emery
for help with figures.

Another Option: APSx3

- This is an evolution of the 1 nm lattice
- Offers three times as many ID beamlines
- Could provide a three-pole wiggler for beamlines that still want bending-magnet-like source
- Downside: Emittance doesn't improve much

APSx3: ~1.5nm



2.1m magnet-to-magnet
in new straight sections.

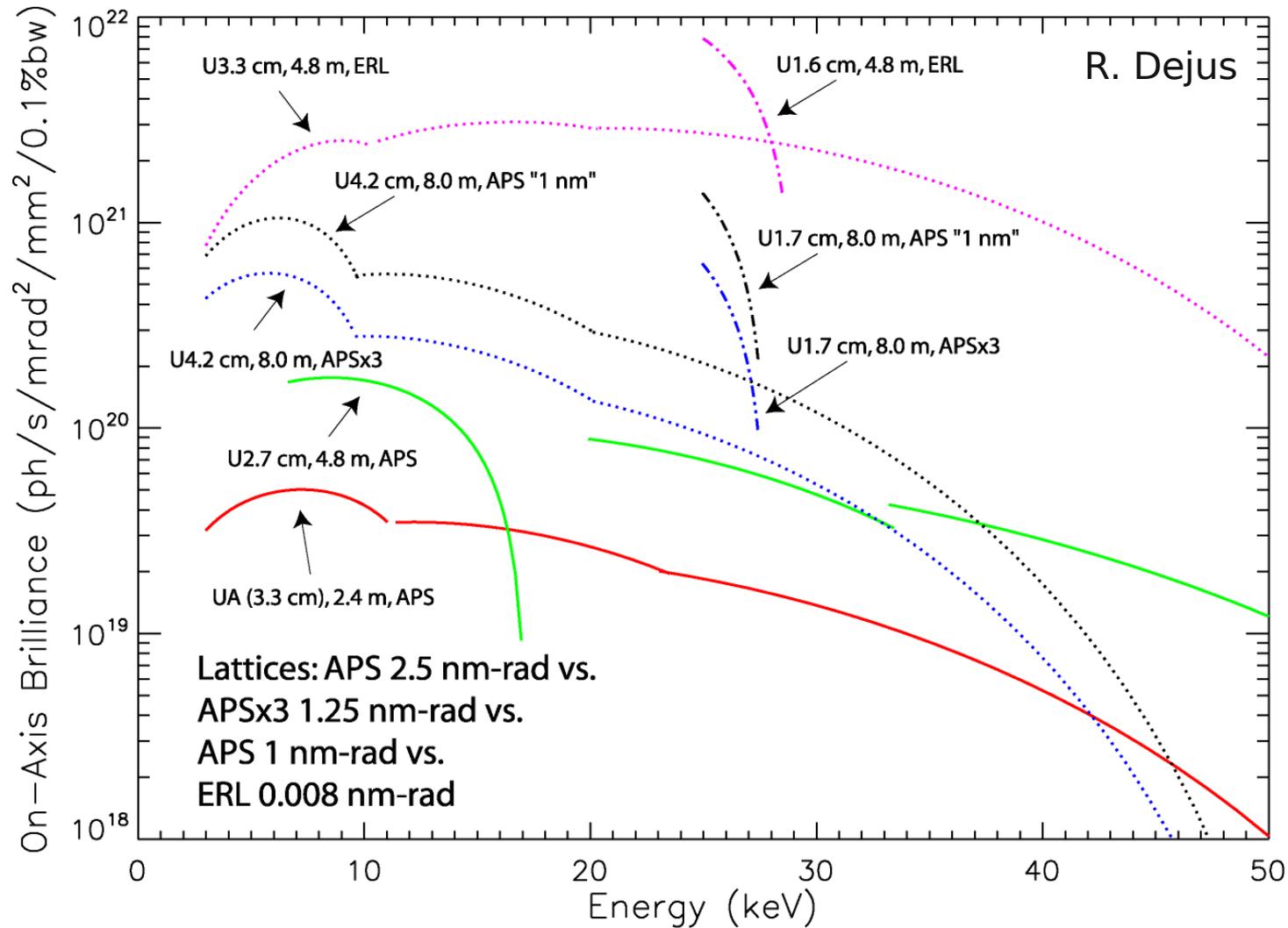
Thanks to L. Emery
for help with figures.

Source Parameters Compared to APS Now

<i>Case</i>	<i># of Sectors</i>	<i>x rms (microns)</i>	<i>x' rms (microrad)</i>	<i>y rms (microns)</i>	<i>y' rms (microrad)</i>
Today	40	275	11.4	8.5	3
APS 1nm	40	~120	~10	~7	~1
APSx3	40	~120	~14	~13	~1

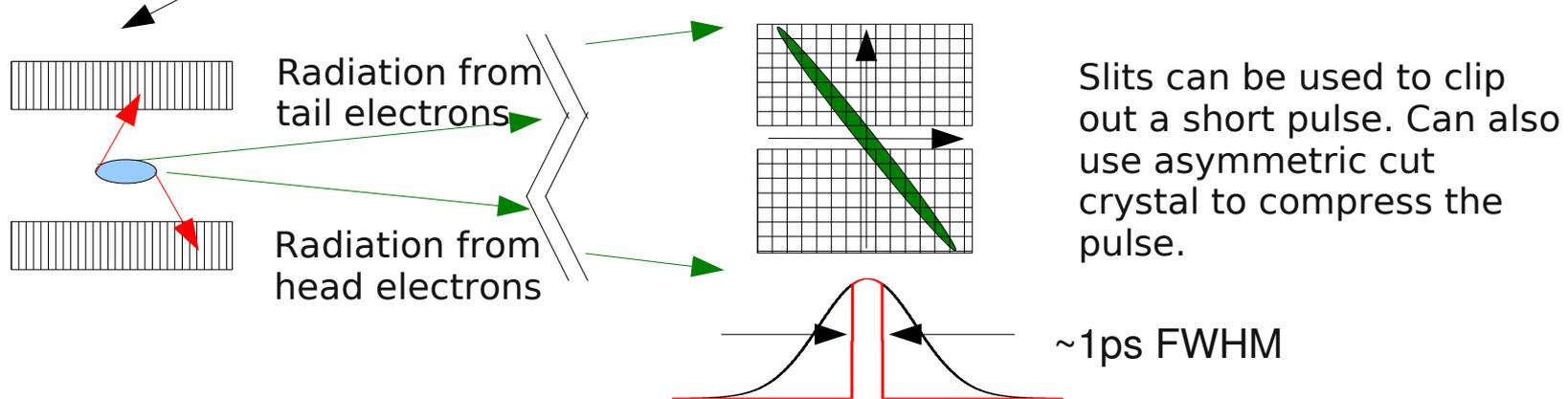
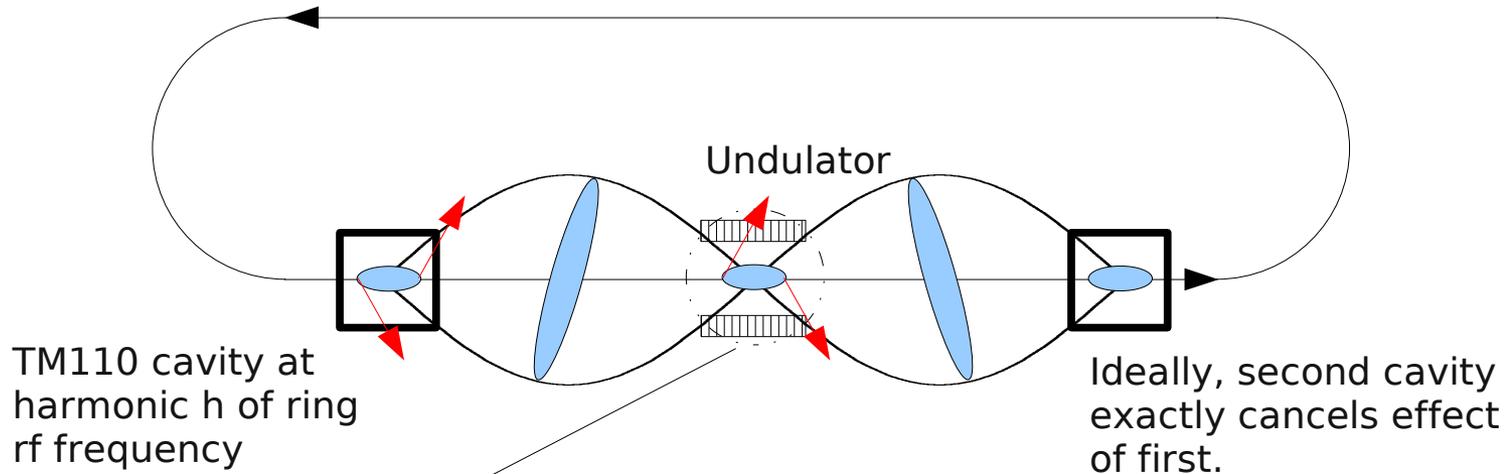
- Upgraded ring would run at 200 mA, 7 GeV
- Insertion devices would be customized to, e.g., maximize brightness consistent with power limitations of front ends.

Spectral Brightness Predictions



- 100 mA (APS), 200 mA (APSx3, APS 1 nm-rad), 25 mA (ERL)

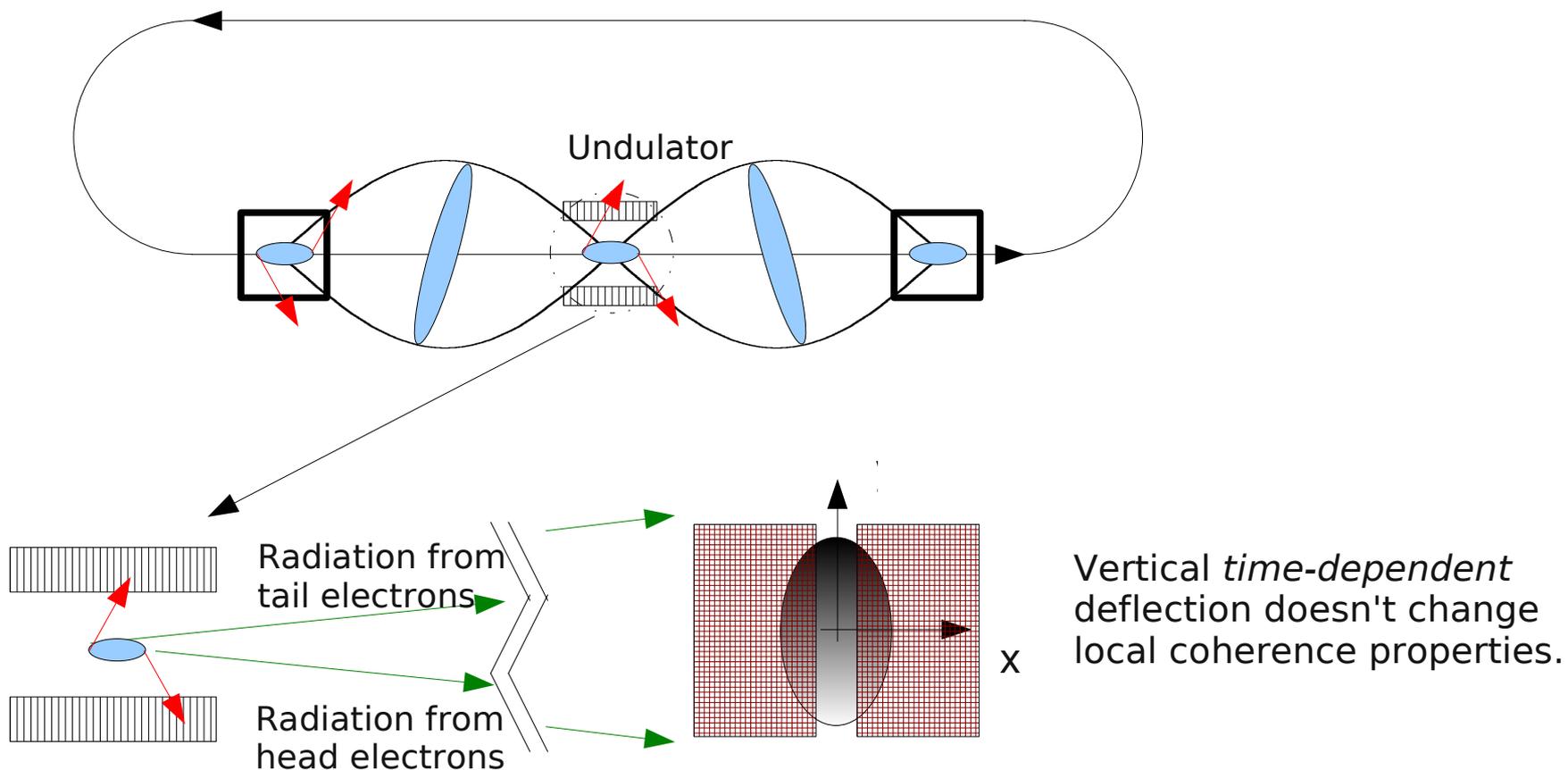
Zholents' Transverse Rf Chirp Concept



$\sim 1\text{ps FWHM}$ possible for existing APS
(K. Harkay *et al.*, PAC 05, p. 668.)

Large Area Coherent Imaging

This is another concept¹ for using a crabbed beam.



¹E. Gluskin

Summary: Ring Upgrade

■ Pros

- Well-known technology, should deliver as promised
- Long straight sections, possibly 3x number of IDs
- Smaller horizontal beamsizes (~120 microns)
- Improved brightness (10~100x)
- Support for ps pulses, large-area coherent imaging

■ Cons

- Lattice flexibility very difficult to achieve
- Considerable dark time required for installation
- Brightness improvement is disappointing relative to
 - *Detector/beamline improvements*
 - *ERL projections.*

Acknowledgements

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